Appendix G

Beadle Center Research

Appendix G:
Potential Impacts at the Beadle Center (distributed to faculty)
Antelope Valley Draft Environmental Impact Statement

Antelope Valley Major Investment Study
Environmental Analyses

June 1998
Work in Progress

Potential Impacts of the Draft Single Package at the Beadle Center

The potential adverse impacts of the Draft Single Package at the Beadle Center were technically evaluated using professionally accepted standards and methodologies. . The purpose of these initial evaluations (contained herein) is to determine if there are any areas where the implementation of the Draft Single Package might create an adverse impact and thus where mitigation may be necessary. All impacts considered are for full build-out conditions which, at this time, include a six-lane arterial located on UNL right-of-way just west of Trago Park and the Malone Community Center. Potential impacts initially under consideration include vibrations, noise, air quality, and lighting. Other topics might be considered in the future depending on the findings of the initial topics and the requirements of regulatory agencies.

The findings are summarized in the pages that follow.

Editor's Note: This appendix documents early analyses (June and October 1998) of potential impacts of the Draft Single Package at the Beadle Center. Additional technical work was subsequently performed (e.g., investigation of the potential impact of airborne pollutants on greenhouses and additional noise analyses with refined Antelope Valley roadway alignments). Ultimately, the Draft Single Package was modified to become the Amended Draft Single Package. This Appendix only reflects the original work.

As reported in this EIS, the revised analyses indicate the new alignments avoid or minimize any potential transportation related impacts to the Beadle Center, without adversely affecting the neighboring parkland.

Vibrations

Three types of potential vibration impacts at the Beadle Center were considered, including:

- Potential impacts to the operation of sensitive microscopes,
- Potential building damage, and
- Potential annoyance.

For each of these impacts, criteria from universally accepted sources were identified, existing vibration levels at sensitive microscope sites were measured, future vibration levels at these sites were predicted, and predictions were compared to criteria to help identify potential impacts. Measured levels from the two sensitive sites selected (N319 & E119) ranged from 0.015 to 0.018 millimeter per second. The following table provides a summary of the analysis:

Impact Type	Criteria	Predicted
Electron microscope operations Up to 30,000 X magnification (millimeters per second)	0.012*	0.014
Building damage (millimeters per second)	5	0.08-0.1 (at 15 meters)
Annoyance to people inside (millimeters per second)	0.1**	0.08-0.1 (at 15 meters)

* Eric E. Ungar, "Vibration Criteria for Sensitive Equipment," Proceedings of Inter-Noise '92, p. 737.
** This is considered the threshold of perception.

Microscope operations. Predicted vibration levels within the research laboratories housing sensitive microscopes will exceed the impact criteria. However, these levels are *less* than existing levels, which are currently considered acceptable. Since vibration levels from multiple sources are not additive and predicted levels from vehicles operating on the north-south roadway will be less than existing levels, no long-term impacts to the operation of sensitive microscopes are anticipated as a result of the Draft Single Package. Impacts may occur, however, during construction. Therefore, construction impacts will be further evaluated.

Building damage. Predicted vibration levels are well below those able to cause building damage.

Annoyance. Predicted vibration levels approach those that may be perceived or felt. However, worst-case assumptions such as continuous soil and no floor-to-floor attenuation were used in the model. More detailed geo-technical information will be considered and more refined predictions will be made during final design. It is anticipated that this additional information will have the effect of lowering the predicted external source vibration levels even farther below the acceptability criterion.

Noise

Potential noise impacts at Beadle Center receptor sites were modeled using the Federal Highway Administration's (FHWA) computer model, STAMINA 2.0/OPTIMA. For each of the sites, FHWA's noise abatement criteria (NAC) for study-area land uses were identified, existing and future noise levels at receptors were modeled, and predictions were compared to federal criteria to identify potential impacts.

Under FHWA standards, all receptor sites at the Beadle Center are considered activity category B (i.e., schools), with a corresponding NAC *less than* 67 dBA L_{eq}. Where predicted noise levels at receptors equal or exceed 66 dBA L_{eq}, therefore, noise abatement must be considered. Noise abatement must also be considered where future noise levels are predicted to be at least 15 dBA L_{eq} higher than existing levels.

Predicted exterior noise levels are reported below for four receptor sites at the Beadle Center. Based on these (and other sites), noise contours were drawn to illustrate lines of equal loudness. The 66 dBA L_{eq} contour would cross over the east-most portion of the Beadle Center. Mitigation should be considered if the existing windows do not adequately attenuate interior noise levels. In addition, future noise levels are predicted to be about 15 dBA L_{eq} higher than existing levels.

Receptor Site	Existing Noise (dBA Leq)	Future Noise (dBA Leq)
I	52.6	70.5
M	56.0	66.4
N	51.9	65.6
O	50.9	67.5

The predicted exterior noise levels above represent vehicles operating at 35 mph on the north-south roadway. However, since the Vine Street intersection is to the immediate northeast, vehicles near the Beadle Center are more likely to be decelerating north to the intersection and accelerating south from the intersection. An innovative technique published by the Transportation Research Board to more accurately model stop-and-go traffic will be used to further refine the model of this important area. Following this, the need to consider impact mitigation will be reevaluated.

Impact mitigation measures typically considered to reduce noise levels include traffic management techniques, physical changes to the roadway, and noise barriers or berms. Traffic management techniques include prohibiting noisier vehicle types, such as heavy trucks, from using the roadway, restricting noisier vehicle types during noise-sensitive hours, and reducing the speed limit. Physical changes to the roadway include relocating the roadway elsewhere, lowering the highway, shifting the alignment to provide buffer zones, using a quieter pavement type, and abating interior noise impacts by insulating residences and public-use facilities.

Few of these measures are practical for the north-south roadway where it passes east of the Beadle Center. Due to the study's adopted purposes and needs, restricting certain vehicle types and lowering the speed limit are not desirable. . Physical changes to the north-south roadway are not possible since adverse effects to Trago Park must also be minimized. Therefore, only noise abatement through the routine installation of acoustical windows and noise barriers would be considered, if deemed necessary.

Air Quality

To determine the significance of the Draft Single Package's air quality impacts, future air quality levels were predicted for sensitive sites. Predicted levels of pollutants, together with the existing background air quality levels, were compared to the National Ambient Air Quality Standards (NAAQS) established to protect human health and the environment.

Although there are several criteria pollutants associated with vehicles, the Federal Highway Administration (FHWA) considers carbon monoxide (CO) to be the most significant pollutant of concern for a study-level analysis. The federal standard for outdoor air quality is an average of 35 parts per million (ppm) over one hour and an average of 9 ppm for an eight-hour average. The federal standard for indoor air quality published by OSHA is 50 ppm for a one-hour average.

The north and east air intakes for the Beadle Center and the eastern air intake for the greenhouse were analyzed for air quality impacts during free-flow and idling traffic conditions using the CAL3QHC dispersion model. The highest predicted CO concentrations in this area result from idling vehicles at the Vine Street intersection. Based on modeling, the one- and eight-hour CO values at the Beadle Center receptor sites would be below all federal criteria.

Air Intake	1-hour avg	8-hour avg	Background CO	Total 1-hr	Total 8-hr
North-Beadle	5.8 ppm	4.1 ppm	2.0 ppm	6.8 ppm	6.1 ppm
East-Beadle	5.3 ppm	3.7 ppm	2.0 ppm	7.3 ppm	5.7 ppm
Greenhouse	3.8 ppm	2.7 ppm	2.0 ppm	5.8 ppm	4.7 ppm

Concerns about other airborne pollutant concentrations have been expressed in relation to the greenhouses and the controlled experiments undertaken there. . Further research would be done in this regard.

Lighting

Future lighting levels incident on plants in the Beadle Center greenhouses were modeled using the Genesis computer program. These predicted levels were compared to existing lighting levels, and measures to reduce future levels were investigated. Threshold lighting levels considered tolerable at the greenhouse complex were not available according to Tom Elthon, Associate Professor.

At the greenhouse nearest the proposed north-south roadway, existing light levels are 1.1 lux (0.11 footcandle). The existing light source at this location is lighting within the Beadle Center parking lot just south of the greenhouse complex. It is assumed that existing greenhouse lighting levels generated by a lighted parking area to the south and streetlights along 19th Street to the west are acceptable.

Lighting sources under future conditions will include street lighting along the new north-south roadway as well as vehicle headlights traveling along the new roadway. Under a future modeling scenario, the roadway could be illuminated to 12 lux (1.2

footcandles), which is the highest recommended luminance value for any roadway. In fact, actual lighting standards adopted during final design may be lower. Modeling also placed the lighting fixtures in worst-case locations, with one directly east of the greenhouse complex. Instead, lighting fixtures could be placed north and south of the greenhouse to minimize lighting impacts. Under worst-case conditions, levels are predicted to be 3 lux (0.30 foot-candle) at the southeast corner of the greenhouse complex. Although light levels drop off quickly away from the road, in this worst case computation, the future level is predicted to be higher than existing lighting levels.

To reduce light levels at the greenhouse complex, lighting standards may be reduced in number or height and lighting fixtures along the north-south roadway may be relocated north and south of the greenhouse complex as explained above. In addition, house side-shields may be placed on light fixtures to block most spill light behind the fixture. And finally, additional evergreen hedges may be planted to further shield the greenhouses from roadway lighting.

While vehicle lights are typically considered when evaluating lighting impacts, these impacts do not apply to the greenhouse complex. Vehicle lights are designed to illuminate the area in front of vehicles, while minimizing side spill light. The direction of travel along the north-south roadway orients vehicles parallel to or turned away from the greenhouse complex. Therefore, these impacts would be minimal.

MEMO

To: Beadle Center Faculty and Staff
From: Karen Sands, DEIS Coordinator, Antelope Valley Study Team
Date: 2 October 1998
Re: Potential impacts at the Beadle Center related to
Draft Single Package, Antelope Valley Major Investment Study

At a June 26th meeting with interested Beadle Center faculty and staff, the Antelope Valley Study Team presented initial findings of the Draft Single Package's potential Beadle Center impacts. As a result of discussions and suggestions at that meeting, additional research has been conducted to address concerns raised. Our responses are provided below:

- Construction-related and post-construction liability issues should be researched.

Impact mitigation measures associated with the study will be specifically spelled out in the Federal Highway Administration's (FHWA) Record of Decision (ROD). The ROD is a document that gives full justification for the selected action and draws heavily on the DEIS, FEIS, and public involvement activities. The ROD must also include a monitoring and enforcement program for each mitigation measure identified. The FHWA will be held accountable for carrying out the actions set forth in the ROD. The ROD can be used to compel compliance with or execution of the mitigation measures identified and committed to. Other liability issues should be discussed with UNL's legal counsel.

- How tractor trailers will access the building's service entrance should be identified.

Delivery bays are located along the south side of the Beadle Center, with access provided via City of Lincoln streets to a parking area south of the building. All necessary access to these delivery bays will be provided as part of the Draft Single Package. The layout of necessary access will be determined during functional design and will be coordinated with UNL.

- Other research facilities in urban environments near transportation facilities should be contacted for case study information related to potential impacts and mitigation.

Ten universities with peer biochemistry departments were contacted to identify how air quality issues are handled at their research greenhouses. Peer departments were identified from a 1995 National Academy of Sciences report titled, "Research-Doctorate Programs in the United States: Continuity and Change," appendix P-5. The results of that investigation and a summary table are provided on the following page.

Research of peer biochemistry departments has proven inconclusive. Of the 10 departments contacted, five do not operate greenhouses. Nearly all are in urban or suburban settings. Four of those responding have research greenhouses, with air filters operating at three of the four.

Agritechnove Consulting, a firm that specializes in the design of research greenhouses, was also contacted. David Brault, a project manager with Agritechnove, stated that he has never encountered concerns specific to nearby traffic and vehicle emissions. Where air quality concerns are an issue (in his experience), they tend to be related to poor regional air quality or to specific research, such as research on the effects of acid rain on plants.

- The standards determining when humans are impacted by air quality conditions should be expanded to also identify plant standards.

The National Ambient Air Quality Standards (NAAQS) typically used as thresholds of impact for air quality studies are comprised of primary and secondary levels. The primary standards are designed to protect public health and the secondary standards are designed to protect the public welfare including, among other things, damage to crops and vegetation. In the case of carbon monoxide (CO) modeled for this study, the secondary standards are the same as the primary standards. Based on study-area modeling, the primary and the secondary standards (which are one and the same) will not be exceeded.

Most other pollutants emitted from automobiles react on a *regional* level rather than a *local* level and, therefore, their study for roadway projects is based on vehicle miles of travel within the region. To compare the effects of alternatives on the regional pollutant burden, the vehicle miles of travel are typically multiplied by emission factors for various pollutants. The total vehicle miles of travel within the region for the Draft Single Package are forecast to be only 0.15 percent greater than that for the No-Action Alternative. Therefore, the difference in regional pollutant levels associated with the Draft Single Package and No-Action Alternative is insignificant.

The University of California—Riverside was contacted for information about their urban air quality concerns at research greenhouses. Based on that contact, air quality concerns have been minimal at the greenhouses which, unlike the Beadle Center, have been fitted with activated carbon filters. Air quality concerns there focus on poor regional air quality—something that doesn't affect Lincoln, NE. If local air quality remains a concern to researchers at UNL, researchers at UCR suggest that foliage planted between the roadway and the greenhouse could mitigate contaminant concerns associated with this study.

A number of major research universities with greenhouses are located in urban environments, where air quality is affected by automobile traffic. The table shown previously indicates that it is not unique that research conducted in greenhouses is carried out in urban environments.

- The vibration analysis should consider impacts to electron microscopes greater than 30,000X magnification.

A reference to electron microscopes greater than 30,000X magnification at the Beadle Center will be added to the text. In any case, vibration levels at the two Beadle Center sites monitored currently exceed the criteria for sensitive microscopes with less than *and* greater than 30,000X magnification, with no known repercussions for research. The goal of the Antelope Valley study is to not produce vibrations greater than those

currently measured. If post-construction vibrations do exceed current levels, then long-term conditions will be restored as closely as possible to pre-Draft Single Package conditions. To do this, the manufacturer may decide to install a floating platform. During construction, however, impacts will be unavoidable as outlined in the following section.

- The tolerances of floating platforms designed to isolate sensitive microscopes should be researched. Will these platforms be acceptable to mitigate vibrations during construction?

The tolerances of floating platforms vary by manufacturer and by installation. It is incumbent upon the equipment manufacturer to install floating platforms appropriately, if deemed necessary, to meet the requirements of the sensitive equipment. The need for floating platforms and equipment, however, is determined by the *manufacturer*. Through this obligation, the manufacturer can meet existing levels if *he* determines a floating platform becomes necessary. Based on our modeling, the North-South Roadway will not cause long-term vibration levels in excess of levels already caused by existing building mechanical systems. Therefore, it is possible that the manufacturer may not identify a long-term need for a floating platform.

It is not likely that floating platforms will be adequate to mitigate vibration impacts during construction, however. The operation of heavy construction equipment and sensitive electron microscopes is simply incompatible. Vibration mitigation used at other sites during construction, including Massachusetts General Hospital, has included early and frequent coordination between researchers and construction contractors. A Memorandum of Understanding (MOU) is necessary to agree when construction can take place, particularly construction involving heavy equipment such as pile driving. In addition, 24-hour construction vibration monitoring is necessary to ensure that peak velocities remain below levels that might cause architectural damage. In sum, mitigation would include:

1. Identifying allowable vibration levels prior to construction.
2. Reaching an agreement with the Beadle Center and contractor about procedures for advance notification of vibration-generating activities and adjusting construction or research schedules.
3. Determining the structural integrity of nearby buildings before construction.
4. Monitoring for cracks in buildings during construction.
5. Continuously monitoring vibration levels during construction.

These measures are not considered unusual and are, instead, standard practice where sensitive equipment is being used near construction sites.

- Provide more information about why vibrations from the Beadle Center's mechanical systems will not be in phase with vibrations from the proposed East-West Roadway.

Vibration waves are characterized by unique wave phases and wave frequencies. It is extremely unlikely that both the phase and frequencies of waves from two different sources (i.e., building mechanical systems and vehicles on the new North-South

Roadway) could ever be in phase. In fact, it is so unlikely that the thousands of conditions that affect vibration waves would make waves from different sources equal, that it is assumed the condition will never exist. What's more, even if the waves are in phase, the resultant decibel level would only be 3 dBA higher due to the logarithmic nature of vibration waves and the way logarithms are added. These theories have been tested in the field by measuring single and double train pass-bys for Metro North in New York City. Given this, only the strongest vibration wave received will define peak vibration characteristics at the Beadle Center. And, both currently and in the future, vibration characteristics are defined by building mechanical systems rather than surrounding roadways.

- Electromagnetic field radiation should also be researched, including baseline information and the Draft Single Package's potential impacts to proposed microscopy and EPR spectroscopy sites that will be located in the Beadle Center in the future (as well as other future technology). The consultant team should also identify impacts to equipment requiring site-to-site transmission.

Little is known about the potential impacts of electromagnetic field radiation on the operation of sensitive equipment. Telephones and radios in automobiles are used throughout the US, however, with no adverse affects to research facilities reported in known literature sources. Instead, literature associated with electromagnetic field radiation tends to focus on electromagnetic radiation associated with overhead power transmission lines.

There are no known complaints of electromagnetic field radiation from existing roadways, including adjacent Vine Street, currently affecting research at the Beadle Center. The introduction of new stormwater management, roadways, and community revitalization measures will produce no large sources of electromagnetic field radiation. Therefore, electromagnetic field radiation impacts on equipment requiring site-to-site transmission are not anticipated as a result of the Draft Single Package.